Versatile Boiler Ash Containing Potassium Silicate For The Synthesis Of Organic Carbonates

Vidhyaa Paroo Indran, a Anisah Sajidah Haji Saud, a Gaanty Pragas Maniam,ab Mashitah Mohd. Yusoff, a Yun Hin Taufiq-Yap c and Mohd Hasbi Ab. Rahim*ad

aFaculty of Industrial Sciences and Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Malaysia
bCentral Laboratory, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Malaysia
cCatalysis Science and Technology Research Centre, Faculty of Science, Universiti Putra Malaysia, 43400 Serdang, Malaysia
dCentre for Earth Resources Research & Management, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Malaysia

ABSTRACT

In this study, boiler ash containing potassium silicate (BA 900) and potassium silicate (K$_2$SiO$_3$) were proven to be feasible Lewis acid catalysts for the synthesis of different organic carbonates (glycerol carbonate, ethylene carbonate, and propylene carbonate) from different polyol (glycerol, ethylene glycol, and propylene glycol) feedstocks. In addition, the developed catalytic reaction has the ability to produce propylene carbonate at milder reaction temperatures. BA 900 and K$_2$SiO$_3$ were reusable for three consecutive reaction cycles without the loss of activity. The reusable characteristics of catalysts were confirmed through several characterisation techniques, i.e. XRD, FTIR, XRF, N$_2$ physisorption, FESEM-EDX, and Hammett test. All organic carbonates synthesised had a similar synthetic mechanistic pathway, which involved decomposition of intermediate carbamates into their respective carbonates.

DOI: 10.1039/C5RA26286K